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ABSTRACT

Few learning centers exist without some level of digital services. On the most basic level, this may be a low-end computer with a printer for word processing. On a more advanced level, there may be dozens of high-end networked computers connected to the Internet. Dartmouth College's Language Lab has gone through various transformations. Until 1987, the mission of the center was clearly defined: to provide language learning support services via cassette tape, playback and recording facilities, as well as copying facilities for all language students on campus. Today, there is still a need for these traditional services, but they are now being delivered via different technologies. Additional services are being requested through new technologies as old technologies fade away. There seems to be little doubt that language centers will eventually transform from a facility that is focused exclusively on languages to a facility that is focused on many disciplines. This paper addresses the challenges of digital versus analog services, network bandwidth, and delivery over internal and external networks, server technology, conversion technology, platform compatibility issues, and implications for learning and teaching. It reports on Dartmouth's experience and provides information on planning for, and implementation, implications, and cost effectiveness of a move to digital services. Fifteen issues that were to guide the implementation process at Dartmouth's Language Resource Center are listed. Of these areas, the following are briefly addressed: 24-hour access; audio, video, and slide quality; CD-ROM packages; compatibility and standards; archiving; distance education; maintaining traditional services, phasing out, and phasing in of digital services; users bearing some of the cost of access; personnel; space; and ownership/copyright issues. (AEF)

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Implementation and Implications of Digital Services in Learning Centers

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Implementation and Implications of Digital Services in Learning Centers

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Learning centers at institutions of higher learning cannot be strictly defined and described. All of these centers somehow developed out of specific institutional needs that recognized the advantages of space, resources, and technology as useful supplements to instruction in the traditional classroom. Learning centers, therefore, developed from language laboratories, library facilities, AV facilities, resource rooms, and laboratories--some serving specific disciplines, others serving a broad spectrum of disciplines--just as present computer centers serve not only students of information sciences, but students of all disciplines in a variety of ways.

In 1999 few learning centers exist without some level of digital services. On the most basic level, this may be a low-end computer with a printer for word processing. On the more advanced level there may be dozens of high-end networked computers connected to the Internet. Dartmouth's Language Lab, for example, has gone through various transformations during the last 13 years. Until about 1987 the mission of our center was clearly defined. The center needed to provide language learning support services via cassette tape, playback and recording facilities, as well as copying facilities for all language students on campus. Today the mission is no longer that clear. There is still a need for these traditional services because language instruction has not changed dramatically over the last thirteen years. But these services are now being delivered via different technologies. Whether the different vehicle of delivery or the improved access will change language instruction remains to be seen.

Further, we see additional services being requested through new technologies as old technologies fade away. While cassette tapes are being replaced by compact disc audio, MP3 players, and streaming network delivery, recent sophisticated technologies like laser disc stations--in high demand just ten years ago--have faded away, due to lack of materials useful in the academic environment and high maintenance effort. DVD is just about ready to take over.

We can also find equipment and machinery in language learning centers often consisting of extremely dedicated machinery, which is maintained by "self-trained" personnel. However, the future situation will be rather different, with new equipment applicable to numerous disciplines, and with the same personnel struggling every day to keep up with the changes.

There seems to be little doubt that language centers will eventually transform from a facility that is focused exclusively on languages to a facility that is focused on many disciplines. It is also possible that other learning centers in other disciplines on campus will provide at least some of the services of the current language centers. Being a director of a language resource center, I can attest to the difficulty in offering the same level of service without the presence of properly trained personnel. These discipline specific services are not only word processing and printing in the less commonly taught languages like Chinese, Japanese, Korean, and Indic languages, but there are also broad technical and pedagogical services on all levels of language teaching and learning, of which I can only list a few here--foreign language e-mail, web browser configurations, handling radio and television sources, digital conversions, text conversions, language learning environments on CD-ROMs and DVDs, and more.

The data on the following chart shows what has happened in my own center from 1987 until today. In some areas planning is underway for the year 2001--but since nobody can (or should) predict the future, I have left many question marks in the 2001 column.

	actual			projected	
	1987	1995	1997	1999	2001
audio cassette stations	50	40	22	10	5(?)
VCR station	none	2	6	6	6(?)
multi-standard VCR	none	3	3	3	3
satellite dishes	1	4	5	9	9
SCOLA	no	yes	yes	yes	no
other TV providers dedicated campus	0	0	2	5	5(?)
cable channels	1	3	4	6-10	10+
laserdisc stations	5	3	1	1	1
DVD stations	0	0	0	1	4
Multi-standard DVD	0	0	0	3	4
high speed canv. copier	1	1	1	1	1
cassette tapes purchased	1500	1000	500	0	0
computers (Mac)	1	7	9	15	7
computers (PC)	none	2	2	6	7
file servers	0	1	5	5	5
file server capacity	0	300meg	4gig	180gig	400gig
AppleShare	yes	yes	yes	yes	yes
NT	no	no	no	yes	yes
Linux	no	no	no	yes	yes
OSX(Apple)	no	no	no	yes	yes
AIX	no	yes	yes	yes	no
streaming video (SIG	no	no	yes	yes	no
streaming video (RTSP)	no	no	no	yes	yes
DDS backup drive systems	0	1	2	2	2
CD burner	1(4x)	2(4x)	2(4x)	2(4x)	2(8x)
CD-R blanks purchased	0	10	100	300	?
DVD burner	no	no	no	no	yes
network Appletalk	20	30	30	10	1
network Ethernet (10BT)	0	10	30	30	1
Network Ethernet (100Base T)	0	0	7	15	30
beds connected to network	all	all	all	all	all
backbone	10	100	100	100	ATM?
visits per week (fall term)	1500	1200	1000	800	500
space occupied		1400	1500	1500	1500
number of languages served	8	9	11	12	13
staff persons FTE	3.5	2.5	2	3	3

If there is a single determing factor for the implementation of digital services it is probably the rapid advance of the capabilities of digital technologies in general. Services of this nature were predictable in the mid-eighties, but were definitely tied to expected increase in CPU speeds, lower storage cost and higher network bandwidths. The chart provides some interesting insight as to where our major investments were made with a generally stable budget. These were: network, servers and server capacity, number of languages taught (always a major investment!), and workstations. Interesting to note: attendance in the center shows a steady drop (we expected that users would quickly switch over to the digital services), purchases of cassette tapes plummeted down to zero, whereas purchases of CD-R media increased dramatically. Our personnel appears to be only slightly reduced by 1/2 FTE during this period. This probably requires some explanation. One of these FTEs is for a manager of humanities computing, providing computing support for faculty in the humanities. Another one is for the director of the center, and the third one is for the assistant director. All three persons are interchangeable up to a certain point. This allows us great flexibility in handling all daily routines with the help of a group of

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trained student assistants. All three FTEs have received a lot of training (or learned on the job) about the new technologies. Implementation of the new services would have been impossible without the enthusiastic cooperation of the staff and student assistants.

We expect that attendance in the center will go down further for reasons already stated, that the number of languages supported will probably go up for reasons of distance education, and that the file server capacity will increase further to provide more materials--while the budget will remain the same.

During the last decade, planning for the implementation of digital services was probably in the minds of all those persons who were watching the progress of this technology, and who were willing to devote time and effort into some futuristic thinking about the role of digital services in educational situations. At Dartmouth we went through several iterations of this--implementing a time sharing system; Avatar terminal clusters in the late seventies; the introduction of the Macintosh in 1983; the introduction of a network reaching to every desk and every dormitory room in 1983; and, most significantly, various software/infrastructure developments: a GUI mailsystem in 1988--Blitzmail, DCIS, the Dartmouth College Information System beginning in 1989; and of course today, text, images, audio, and video via the network--as part of the information system as well as part of various centers at the institution.

In our implementation of these ideas at Dartmouth, the basic convincing arguments for the implementation of digital services were 24-hour availability, similar if not better quality of service, long-term cost-saving, and long-term positioning of the institution in the use of the Internet for purposes not yet fully discussed. Another important argument was the utilization of Internet II and the possibility of cooperating with other institutions with similar bandwidth for research and instructional purposes.

No precise overall plan for the implementation existed. Instead, "management" signalled that it was all right to experiment and that the backup infrastructure would be provided. That was all that was needed to get a number of people on campus excited.

With Dartmouth's decision in 1993 to redo its network, some realistic thinking about the delivery of digital services and bandwidth could begin. The decision making process was not easy. Dartmouth had established one of the largest AppleTalk networks in 1983 that was already reaching to every bed, office, and classroom on campus. Hardware and software connecting more than 6000 users was almost completely "in-house" development. Therefore, there were advantages and also disadvantages when compared with commercially developed hardware and software becoming avaible in the late eighties. But in 1993 the network was simply too slow for the services we wanted to implement!

Re-installing the network was a major effort that was to eliminate more than 20 years of various generations of hardware. This consisted not only of outdated computer networks, but also of the telephone networks and the campus cable co-ax network. In addition, it also meant the institution would regain control over a network that had been extended by various departments and laboratories for their own needs through additional wiring, extensions, and cascading. This two year process included 1) removing every piece of wiring in all buildings that was not part of various alarm systems, HVAC, or electric power, 2) the installation of central service points in every building, and the installation of raceways, conduits, and outlets, 3) the installation of of a fiber back bone with all the necessary hardware providing Internet II access, and 4) discussions with most individuals and departments on campus to determine local needs.

In many instances we ended up with compromises that could be changed easily in the future. These compromises were: shared ethernet in most places rather than switched ethernet. Shared 100BaseT rather than switched 100BaseT. No fiber to the workstation, but CAT5--expecting that this type of wiring would be sufficient for a while to keep up with higher ethernet speeds. No dark fiber was installed.

While the network was being installed in various locations on campus, an ad hoc group discussed bandwidth requirements, storage needs, and prospective technologies for audio and video services. The best decision, having been influenced by budget constraints as well as the experience we gained from other institutions, was to avoid buying into dedicated hardware and software packages which ran at

above $100,000 at the time the discussions took place. We knew that we would fall behind a few illustrious institutions but were quite convinced that we could do better from scratch and with future technologies "to be available soon." Our second best decision in the process--not really a decision but the way we let things happen--was an "experiment and wait" kind of attitude that saved us enormous amounts of money but still allowed us to become comfortable with the required technologies, provide demonstrations to faculty and students, and implement some limited services in controlled environments, i.e. the Language Resource Center. (It is always easy to describe the process after the fact. The dynamics of these processes are far more complex than I could describe here. The driving force behind all this lies probably with some people who are not *directly* involved in instruction, but have the understanding of what digital technologies can possibly do for instruction. In other words, it was not the faculty pushing for these services.)

We identified about 15 issues or areas that were to guide us during the implementation process:

1. 24 hour access to most materials

2. digital services had to be at least as good as existing analog services

3. all services had to be PC/Mac compatible

4. file formats had to be within industry standards with strong support by vendors

5. delivery schemes for distance education should be kept in mind

6. traditional services should be maintained until digital services became accepted and stable (maintenance of parallel technology)

7. commitment to a fast phase-in of complete audio digital services

8. long-term goal of complete elimination of analog services

9. users bearing some of the "cost of access"

10. digital services must be cheaper than analog services after initial phase

11. long-term reduction in personnel, but higher qualification

12. hardware investment no longer dedicated to a specific discipline

13. long-term reduction in required space for maintaining services

14 . improved handling of copyright issues

15 . expected significant impact on teaching and learning

Time does not permit me to provide exhaustive details on all of the above. But I will try to address some of those points where we accumulated some experience.

24-Hour Access

This appeared to be the most convincing argument for the introduction of digital services. Our present lab is open for about 84 hours every week. Still, all of us who work at universities know that students as well as faculty want to have access to libraries and other facilities on a 24-hour basis. When I started to check the logs of our servers, I found that the peak server hours were at one o'clock at night and at 7:30 in the morning. The nighttime surge is no surprise, and the morning surge is probably a Dartmouth specific phenomenon, since our language drill sessions start at 7:45 and we assume that students prepare themselves for these sessions by turning on their computers.

Audio Quality

Since we were dealing with languages, the audio quality of existing master tapes appeared to be the standard for the digital lab. Unfortunately, master audio tapes are almost always second or third generation when they are sent out by the publishers to the consumer. These tapes contain not only a lot of noise but also have additional flaws accumulated through several generations of high speed copying processes. We had no choice but to use these less than perfect materials for our first implementations. In the long run, it may be better to request the original digital masters from publishers and transfer the digital data directly to a server. I would not rule it out at all that publishers may force institutions to use audio materials on the publishers' web sites to assure the best quality for all users. But this is a step that can only be taken once 1) appropriate bandwidth is available to all, and 2) a sensible billing mechanism is available that protects the publisher's interests and makes these materials available at a reasonable cost to the consumer.

Digitizing of audio materials is performed on mid-level machines on most platforms, with commercial software that is easily obtainable. Digitizing has to be done in real time. In other words, a thirty minute audio cassette tape will be digitized in exactly thirty minutes. Most digitizing software is capable of setting the process to various sample sizes like 8-bit, 16-bit, or 32-bit resolution and sample rates between 8 and roughly 44k per second. Most digitizing software is also capable of producing various file formats or converting one file format to another. Just like producing master tapes to the highest specifications, implementers of digital services should consider storing the highest possible quality (or at least a level of digitization that renders the complete range of the original). Obviously this approach requires enormous amounts of storage so that a compromise is indicated.

In our tests with various audio tapes used in language laboratories we discovered very soon that we would not need compact audio disk quality for materials that came not even close to it on tape. In addition, we had seen the experience at Otago University in New Zealand which had implemented a digital audio lab in 1993 that used final data rate 5k per second. This low data rate was produced by using digitization at 16-bit/44k and compression to 8-bit/22k at IMA 1/4. The final product was hardly distinguishable from the original tape.

The resulting file could be played directly. It could get decompressed and saved in various formats. We decided to put it into a QuickTime container to make it compatible for the PC and Mac platform. The total space requirement for all audio files in use during the fall term 1999 is about 10 gigabytes--representing about 1000 C30 tapes, backed up on approximately 35 CDs.

More important than all of the above was our decision to "edit down" the audio tapes to the exercise level. The problem with analog services from cassette tapes is that it is time consuming and frustrating to go to specific exercises, or drill on a 30-minute cassette tape. Sometimes the tape needs to be fast-forwarded to the exercise which can take close to two minutes. Then it may need to be rewound for an exercise at the beginning of the tape, another two minutes. With an "edited down" tape the student can open the workbook and access in seconds the tape section that he/she needs. This "editing down" was performed by several Dartmouth students who were competent in the respective languages.

Video Quality

Whereas dealing with audio materials was relatively straight forward, dealing with video materials was far more challenging. Fortunately, recent technological developments have solved many of the challenges we encountered but have also made a number of vendors vanish from the market. Today we can produce video in acceptable quality with off-the-shelf software and hardware and off-the-shelf machines.

I first saw digital video in the form of a stamp sized window in a Hypercard stack in 1989 at a demonstration by Apple in Munich, Germany. I was immediately taken by the enormous possibilities lying in the simultaneous handling of moving images, audio, and text on the computer screen. Only three years later, David Bantz and I demonstrated a learning environment that contained parts of Goethe's

Faust with text, video, audio, and more.

But our implementation of digital video needed a far higher quality than what we could produce then, and it also had to be capable of being stored in reasonable amounts of space and served at reasonable bandwidths. Commercial providers early on had jumped on the bandwagon of MPEG-1 and streaming servers based on dual or quadruple processors feeding via FDDI or ATM into switches connected to networks. Clients either used special hardware to decode the streaming signal or high-end machines that could decode with appropriate client software. Servers used large arrays of hard drives to provide enough space for mounting dozens of hours of videos. According to the companies, 25, 50, or even a 100 clients could look at the same file at different positions. We did not buy one of the packages but opted instead for a piece of software that enabled us to install a minimal server for 25 clients on an existing high end workstation. The server worked fine for us in Windows and NT environments with very acceptable picture and sound quality. The promised Macintosh client has not been delivered in a stable version yet. Since our campus is even today 80% Macintosh we would have been in deep water had we relied on this particular company. This no-cost waiting permitted us to see the development of other options in the video area and even test out some of our own.

While we were waiting for a stable Macintosh client for the video server, we decided to do some testing with an AppleShare server in the language lab. To our great surprise, video and sound came across quite well. We went up to about six clients with satisfactory results, the seventh client began showing hiccups and the eighth only had intermittent video and audio. An increase in CPU speed to 350 MHz and a switched 100BaseT connection for the server to the Intranet solved that problem easily, and provided services to dormitories as well. I do not know how many clients we can serve with the AppleShare Server, since we have only tested as far as 13 simultaneous clients.

We put the same files on an NT server and observed a rather similar performance. Let me remind you that we were dealing with MPEG-1 which requires around 150k per second. Since we were not dealing with streaming, the complete overhead of file services from the NT environment and the AppleShare environment came down with the files, lowering the available bandwidth somewhat. But with this approach we had an environment that we could let faculty and students use and collect feedback from them.

Production of MPEG-1 can be done in real time on special hardware or in a slow fashion with special software. Nowadays, MPEG-1 hardware boards are coming down to less than $1,000 and produce reliable results. Problematic in MPEG-1 production is the lack of sophisticated editing and video control capabilities. Most boards and their respective software allow only cutting at the beginning or the end of a file. Image size, color, contrast, and saturation cannot be set. But bit-rate for video and audio can normally be adjusted.

In general, we accepted smaller flaws like a slightly imperfect frame or color balance for the convenience of the production. We started using the 3DO board but later switched to the ButanеII board. 3DO has disappeared. The ButanеII vendor (Wired, Inc.) is still around and has been a reliable vendor for us.

Other digitizing methods depend on software compression and can take enormous amounts of time, like 20 to 40 minutes for a one minute clip. Additional choices are 1) M-JPEG, producing comparatively large files, and 2) the Sorenson codec, which is extremely slow in production but produces excellent results at low bit-rates. A special hardware solution has just become available for the Sorenson codec. But even this hardware does not encode in real time. A $9,000 investment results in a factor of 6 minutes of processing for a one minute video clip. This is much better, but still not as good as encoding in real time.

Quality: Stills

Dartmouth's slide collection for art history is already partially converted. Other slide collections on campus are being digitized slowly. In most cases standard slide scanning and flat bed eqipment is being used for scanning in resolutions that are appropriate to the needs of the discipline. Art history, in

particular, expects the highest resolution with zooming capability into sections of each image. Other disciplines are more willing to make compromises, putting the number of available images ahead of the quality of each individual image. Slide collections being used as realia in language instruction are normally low level JPEG format and are served via a web interface. Slide collections in the art history department are served through a special Dartmouth-developed interface at much higher resolutions that allow zooming.

CD-ROM Packages

Learning centers have growing collections of various CDs for individualized learning or as supplements for textbooks. If these CDs are properly constructed (assuming the license arrangements are favorable) they can be mounted on servers and will be accessible to one or multiple users. This is an enormous advantage over letting users handle irreplaceable CDs on machines in the lab. The performance of CDs over the network is as good as on a CD drive on a lab machine. Copying a whole CD into the server is another option, especially when enough server capacity is available.

Compatibility and Standards

Audio and video file format compatibility for Windows and Macs has improved over the last year. In the past we used to save files in PC formats as well as Macintosh formats in order to serve them on the respective servers, i.e. NT and AppleShare. There were many reasons for this that I no longer need to address in detail, because things have changed so much. Among the many blunders we made in our implementation, there was one that caused us some real time-consuming efforts. Being Macintosh users we had ignored PC naming conventions and were forced to rename literally hundreds of files to make them playable on both platforms.

All of our audio files used to be in IMA compressed QuickTime format. We decided to change the "container" to what is called "hinted QuickTime." A hinted QuickTime container can be played through Media Player on a PC, and it can be played through MoviePlayer on a Macintosh. Last but not least, the hinted QuickTime format can be served from a shared partition on a Mac OSX server, or from a shared partition on an NT server. And, it can also be played from a streaming QuickTime Server on an OSX Server. Our main server for audio, therefore, is now a streaming QuickTime Server accessible through web pages working just fine for either platform. This has solved all of our compatibility problems for audio files.

The situation for video is not quite as simple. We do not have the option (yet) of converting MPEG files into a format that is acceptable for the streaming QuickTime server. Apple has hinted that it is close to providing this solution. At this point, we are serving video from an NT Server to both Macintosh and PC clients. The server contains so-called raw MPEG files that can be viewed with MediaPlayer on the PC side and with MoviePlayer 4 on the Macintosh side. In the long run the video files have to be served from a streaming server as well so that we can be sure that we can satisfy the needs of large numbers of simultaneous clients. Assuming that industry will provide this solution, the dream of a streaming video and audio server for less than $2,000 would become a reality.

Archiving

Some institutions have acquired enormous amounts of materials that are on reel-to-reel or cassette tape as audio or video files. The life expectancy of these magnetic media is anywhere from a couple of years to about thirty years depending on the quality of the tape and the storage conditions. We decided to archive our digital data on CD ROMs hoping for a life expectancy of about thirty years, more or less. We find it very important that two copies are kept of all materials and stored in different buildings. Storing on DVD discs would also make sense. But CDs, at least at this moment in 1999, are a far cheaper storage medium than DVDs.

Distance Education

We have tested our setup from various universities on Internet II with expected excellent results--in most

cases as good as on our campus. With other connections one can expect at least good audio. The implications of the streaming server technology for distance education are well known and I do not need to dwell on them here. Industry has sent signals that they believe that this technology is ready to use for broadcasting special events at any time now. Our experience indicates that this is correct as long as the size of the video window is kept reasonably small so that data rates stay at 25--35 KB. Broadcasting can also be implemented through the use of RealServer technology, but at a higher price.

Maintaining Traditional Services, Phasing out, and Phasing in of Digital Services

Things have to work well and must be totally reliable. There is no point in switching over to digital services when quality and reliability cannot be met. Our declared policy from the beginning was to maintain complete "parallel technology"--in other words, maintain the traditional services completely while spreading the word that digital services were also available. We went through a whole year of this approach, with users not minding occasional shutdowns of servers, since all had been warned often about the experimental nature of these services.

In our case, we started with a 50 station audio lab and established limited digital services while reducing available conventional stations to 20. This worked well, because with a single server and exclusive AppleShare services we needed to deal with several breakdowns. This year we reduced the number of stations to 10 but tripled the server redundancy to three in order to allow Mac users to access files at three locations and PC users at two. This was a very wise decision, because our main AppleShare server broke down three days into the term with some hard disk problems. Even with the loss of one server we were able to satisfy all client needs with the remaining server until a replacement 18gigabyte disk arrived.

At this point, we have no plans to phase out our last ten traditional workstations. Since we did not implement recording capabilities in our system, clients who think they need this capability can still use the traditional cassette machines. We expect to implement recording in the future but do not feel any urgency or pressure for this feature from faculty and students.

Students have accepted the digital services rather nonchalantly. They expect this kind of service from a high-tech university just as they expect the library catalog, e-mail, and the internet on their own machines. Faculty--and this is the case in many institutions - normally stays away from services provided in language labs. But with the advent of fully-equipped classrooms with data projection and complete access to the servers, we have seen some instructors integrating the technology into their classes. There is the Chinese language instructor who runs the ten characters of the day on the projection screen in automatic mode before the class starts. There is the film studies instructor who has about a dozen short clips on the server to support his lecture. There is the Russian instructor who goes over the lab exercises in the workbook while running the audio track in the classroom. And there is the linguistics instructor having almost complete access to all her sound files on the server when lecturing or answering a student's question.

Users Bearing the "Cost of Access"--More Cost-Effective Services

Our students are required to have a computer while on campus. This allows us to keep the number of workstations in lab clusters across campus fairly small. We have not done any exact cost comparisons between the traditional lab and the new digital services, since today's situation is more or less a hybrid one. In the long run, especially if a dollar figure is attached to the 24-hour access and the dramatic increase in the number of users who can be served simultaneously, the equation would probably look very much in favor of digital services. Today, traditional equipment and maintenance cost are probably about the same as the cost of servers and other necessary devices for the delivery of digital services. In the future we can expect further reductions in the cost of providing digital services and we can probably forecast tremendous improvements in the quality of delivery.

Personnel

The traditional language lab director or learning center director as well as his/her staff has seen some

significant changes over the last decade. Video, computers, CDs, and network have invaded a space that had not seen any significant changes in technology since reel-to reel-tape was first introduced in the mid-fifties. Job descriptions for recent openings for managers of language labs, learning centers, media centers etc. are looking for persons that simply do not exist. Institutions are looking for supermen or superwomen that have at least language teaching experience at the college level, are familiar with language acquisition theory, are competent in using PCs and Macintoshes, are competent in web design and writing JavaScript, are competent in network issues, can train faculty in the application of these new technologies, are familiar with the technical requirements of the less commonly taught languages, i.e. Chinese, Japanese, Russian, Hebrew and possibly Korean and Indic languages, have a Ph.D., can teach at least one course per term, and are willing to begin with a salary that is about half of what is offered to an Assistant Professor on the tenure track. None of us are so superhuman that we could perform all these tasks really well. A keen interest in the new technologies as well as an enthusiasm for learning appears to be the most desirable quality of persons wishing to enter this profession. From a professional point of view, a more comprehensive and precise definition of training and responsibilities of learning centers is needed.

Some institutions are now providing training at the graduate level for media specialists or educational technology specialists. This is a good beginning. I feel that an apprenticeship of about a year in one of the major institutions, which would concentrate on computing services, AV services, language service as well as instructional technology in the classroom after a graduate degree in any field, would be a good starter for persons wanting to enter this field.

Some of the old hands in the field have made the transition with enthusiasm and feel very comfortable with their totally changed job descriptions. Others have given up and allowed campus politics take over their domains--with computing services, AV services, libraries, or faculty committees presiding over the demise of broken down equipment in a more or less abandoned basement room.

There is very little work left that can be performed by low-level personnel--the times of the "curator of tapes" are over. The new learning center requires less, but more competent personnel. Even digitizing materials requires the competent judgment of a person with at least some experience in the language. Editing materials requires more linguistic experience. Troubleshooting, configurations, and training requires experience that can only be gained on the job.

In other words, learning center personnel will have to be truly professional and should be respected as such. If an institution expects the director to train faculty, then the director should be respected as an equal and should receive similar pay and benefits. This refers particularly to training and sabbaticals as well as travel allowances.

Space

Depending on the institution's utilization of digital services, most space should be repurposed somewhat and optimized for the new technologies. Actual space savings are possible, especially in those situations where generous space was allowed in the past for the public as well as for production, archives, and offices. Repurposing of space should first of all emphasize a secure server room, a secure archive, and comfortable production space. Secondly, again depending on the respective institution's needs in space planning, it should emphasize group meeting areas and individual workstation areas that are completely equipped. One can safely assume that all standard work requiring audio and video is probably done via the network. More sophisticated work like word processing and printing in Chinese, video-conferencing, and learning with self-access materials will probably be done in the center. A learning center should also archive its materials in different buildings to prepare for catastrophes like fires or earthquakes.

Ownership / Copyright Issues

Learning Centers, libraries and AV facilities are not very popular with their clients when they have to refuse to copy tapes or other media for various purposes.

Originally the purchase of a tape set accompanying a textbook provided permission to make as many

copies as needed for *x* number of workstations in a lab. Some publishers also permitted the production of copies for students as long as this service was provided for free. Digitizing such tapes and making them available over the network seems to pass as fair use in many institutions and many publishers, when asked, have given permission for this.

The purchase of a video tape, on the other hand, does not enable the center to make copies. A client can take the tape and play it on a video station. Digitizing the tape and allowing a single user to view it via a network is probably contrary to fair use, since the original has been transferred to a different medium and will not get used up with subsequent showings. Providing access to multiple viewers on the same file is probably an even worse scenario from the lawyers' perspective. The situation is more complex with foreign tapes coming in different standards that can easily be changed into digital format.

But this is not the place to go into any further details. These are very important issues that will have to be solved in talks involving all parties. The IALL (International Association of Learning Laboratories) has already had one long meeting with publishers' representatives to discuss the issues involved. I am sure that all parties are quite reasonable and will arrive at a consensus that will allow learning centers to provide commercial materials in sensible ways.

Let me finish my remarks with a few demonstations of the Dartmouth digital environment.

Demo 1. This demonstration will show the web entry point for all audio resources that used to be on tapes in the language resource center. Students click through the hierarchy of directories to arrive at specific audio files for activities in their workbooks or lab manuals. The use of this website requires a browser and a QuickTime 4.0 (or higher) installation. We'll play one audio file via the internet.

Demo 2. This demonstration will show the entry point for the NT-server that contains the same audio materials as the web server. In addition, this server contains all video files that are in use in undergraduate language instruction. The NT-server is a so-called "shared environment" and is visible to users on the AppleShare network and on the NT network, which, of course, are running on the TCP/IP based campus ethernet. We'll try to play the same audio file which we played from the web server. We'll also try to play a video file, depending on the available bandwidth.

Conclusion

Digital services are the way to go. They are accepted, they are used, and they are here to stay. We had feedback from about 200 users last year with generally positive results. This year's feedback so far has focused on a single issue: when are the servers up again? As you may be able to imagine, up North, we do have occasional power failures and servers do not always come back by themselves….